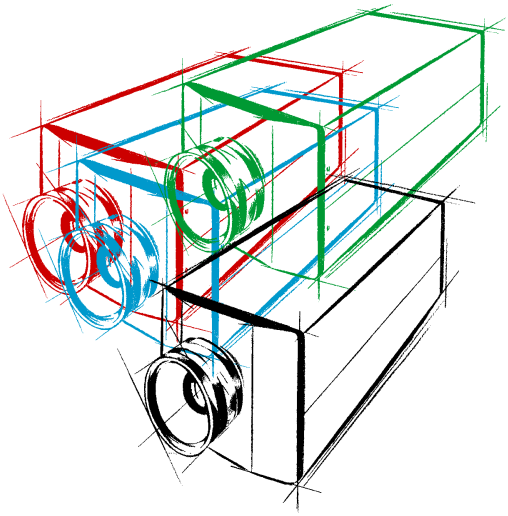
VC45
VM45

Operating Instructions



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Safety Instructions

For your own safety and in order to guarantee a safe operation of the camera, please read carefully the following information prior to using the device.

- Never operate the camera at places where water or dust might penetrate.

- Place the camera on a sufficiently stable basis.
  Shocks like e.g. dropping the camera onto the floor, might cause serious damage to the device. Therefore exclusively the tripod attachment at the bottom side should be used for mounting the camera.

- Always unplug the camera before cleaning it. Do not use cleaning liquids or sprays. Instead, use a dry, soft duster.

- Make sure that the connecting cable is in good condition and that the link to the socket does not represent an obstacle.

- Detach the camera and contact the customer service in the following cases:

  – When cable or plug are damaged or worn-out.
  – When water or other liquids have soaked into the device.
  – When the device is not properly working although you followed all instructions of the user's manual.
  – When the camera fell to the floor or the housing has been damaged.
  – When the device shows apparent deviations of normal operation.

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Operating Instructions VC45/VM45
Version 03/99

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VC45 VM45

This manual contains important information and instructions for the use of the **Video Camera VC45** and the **Video Module VM45**.

If you work with a Video Camera VC45, you will find all necessary information in Chapter 1.
Chapter 2 includes additional information when working with a Video Module VM45 (= VC45 without housing).

1. Video Camera VC45

1.1 Features of the Camera

The video camera VC45 is a high performance monochrome camera, based on a solid state image sensor. The high quality "lens-on-chip" CCD, combined with an advanced electronics, increases sensitivity of the VC45 substantially, compared with high standard video cameras. An absolute black level is achieved via special darkened reference pixels, yielding a perfect linear relation between light input and output signal. A great number of additional features makes the VC45 suitable for nearly every application.

Video Standard

The VC45 is easy to use. The analog video signal is a CCIR, respect. a RS170 standard signal and compatible to the whole video equipment on the market.
With a potentiometer at the rear panel of the camera the gain can be set externally.

Shutter Control

An integrated shutter control allows exposure times from 100µs to 20ms (CCIR) respect. 16.7ms (RS170). It can be set by DIP switches, parallel or serial input.

Long Exposure

A long exposure time can be generated up to 20s by an external or serial input. When using the external input a special power down mode prevents the CCD from additional dark current. There are two integration modes possible: FRAME interlaced and FIELD interlaced.

The sensor of the VC45 is absolutely insensitive against overexposure, i. e. too much light cannot damage the CCD sensor.

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1.2 CCD Sensor

Overview

The following CCD sensors can be used in the camera:

CCIR

format	resolution	pixel size	active sensor
1/2“	741 x 576 pixel	8.6 x 8.3 µm	6.4 x 4.8 mm
2/3“	741 x 576 pixel	11.6 x 11.2 µm	8.6 x 6.5 mm

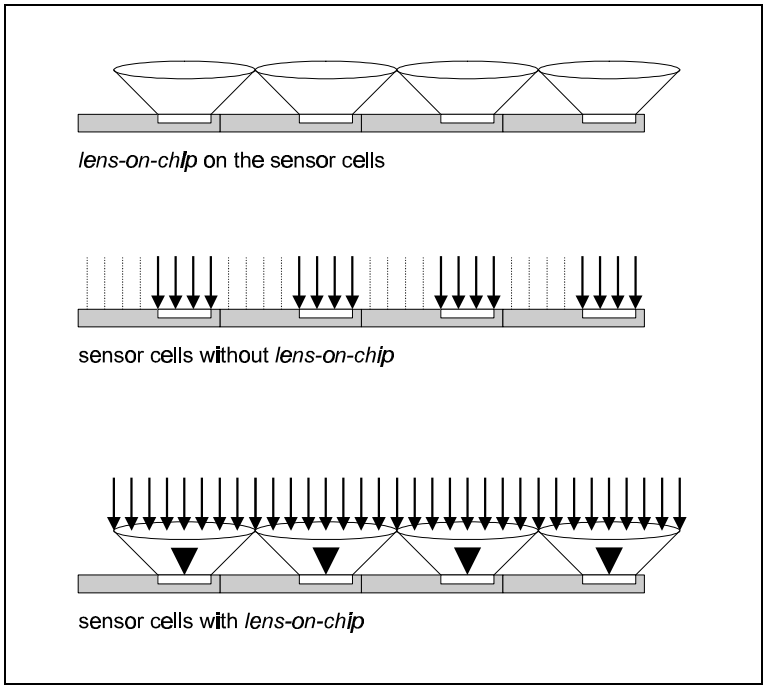
RS170

format	resolution	pixel size	active sensor
1/2“	756 x 486 pixel	8.4 x 9.8 µm	6.4 x 4.8 mm
2/3“	756 x 486 pixel	11.6 x 13.5 µm	8.8 x 6.6 mm

Lens-on-chip

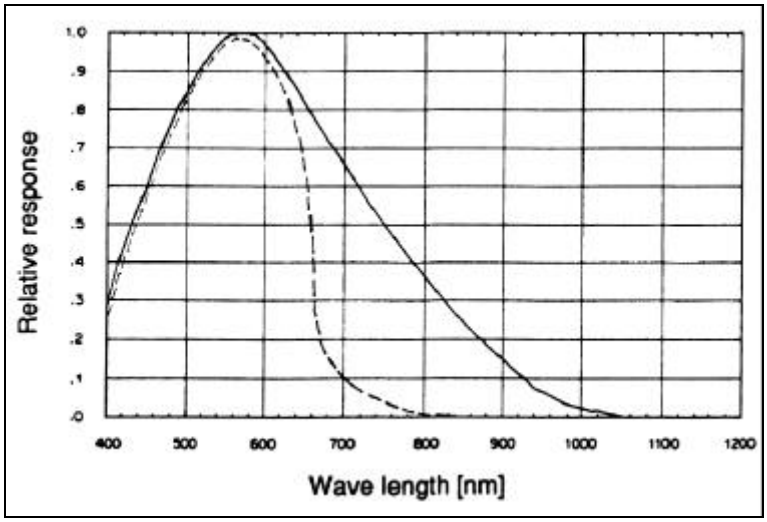
Each of the used CCD sensors have the “lens-on-chip“ integrated which increases the sensitivity of about factor 2.

The following drawings show the principle function of the lens-on-chip technical.



Spectral Response

The following drawing shows the spectral response of the used sensors. Optional the VC45 is available with an infrared cutting filter. All wavelength higher than about 680nm will be cut off.



——— = without filter
..... = with infrared cutting filter

1.3 Connections

Lens Mount

The VC45 uses a C-Mount with a standard back focal length of 17.52mm (distance between the front edge of the C-Mount insert and the focal plane of the CCD sensor). The C-Mount has a fine adjustment to allow for small variations in the focal length of instruments.
To adjust to a different back focal length, just loosen the set screw at the bottom of C-Mount front plate. Rotate the C-Mount insert to the desired position. (The C-Mount insert has a 0.5 thread suitable for fine adjustment.) Then secure the insert again by tightening the set screw.

Power Supply

The power supply (230V), delivered with the VC44, provides 12V (-5%, +10%). At 12V the power consumption is about 300mA. On the power supply a 12-pin special connector is mounted.

Video Output

The analog video output (BNC socket) supplies a standard video signal ($1V_{pp}$, 0.3V Sync-Level on 75Ω) according to CCIR or RS170 standard.
The video signal is compatible to all video equipment like recorder, printer, monitors, ...
Please use only 75Ω cables (e.g. RG59)!
Some monitors need an external Sync-signal. In this case you need a connection between VIDEO OUT of the monitor and SYNC IN of the monitor.

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Pin Assignment

The 12 pin socket at the camera rear panel has a standard pin assignment as follows.
Please note that there are also special pin assignments possible. In this case a separate pin assignment is enclosed.

12 pin socket of the camera rear panel

pin	signal name	level	function	input / output
1	POWER GND		ground	input
2	POWER +12V	+12V DC	input power	input
3	EXP	TTL	exposure	input
4	EXPD	TTL	exposure power down	input
5	ENB	TTL	enable shutter	input
6	ED0	TTL	shutter control	input
7	ED1	TTL	shutter control	input
8	ED2	TTL	shutter control	input
9	CSYNC	TTL	composite sync	output
10	VSYNC	TTL	vertical sync	output
11	MODE	TTL	frame / field integration	input
12	GENLOCK	Video, TTL*	genlock	input

* signal level from 1 ... 5V is accepted

POWER GND Ground

POWER +12V Input voltage 12V (+10% / -2%)

EXP Long Exposure Control input

TTL level
The exposure time can be prolonged by a low signal.
Typical time range between 40ms ... 10s.

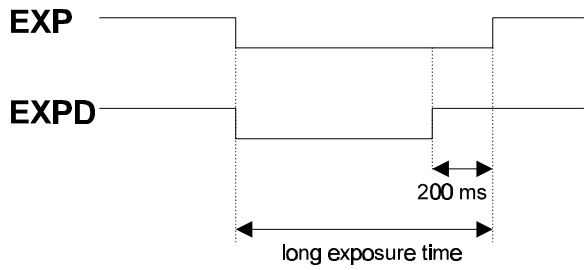
This input is checked at any rising edge of the VSYNC signal (= end of the VSYNC). When the input is low, the integration time will be prolonged for the next field/frame.
In the field integration mode multiple of 20ms will be exposed, in the frame integration mode multiple of 40ms will be exposed.
The input is connected to a pull-up resistance.

Remark The Long Exposure Control can only be active when the module is in the parallel mode **and** the shutter is off!

DIP switch S1/pin 7 = open
DIP switch S1/pin2 = closed; ENB don't care
or
DIP switch S1/pin2 = open; ENB = low

EXPD Long Exposure Power Down input

TTL level
For long integration times, the sensor can be set in a power-down mode. This mode avoids the generating of an additional dark current.
This input can be set parallel with the EXP input but must be re-set at least 200ms before the EXP is reset.



The input is connected to a pull-up resistance.

Remark The Long Exposure Power Down can only be active when the module is in the parallel mode **and** the shutter is off!

DIP switch S1/pin 7 = open
DIP switch S1/pin2 = closed; ENB don't care
or
DIP switch S1/pin2 = open; ENB = low

ENB Shutter speed setting, parallel or serial input.
ED0
ED1
ED2

Parallel Input Only the high-speed shutter is used when using parallel input. (During frame accumulation, low-speed shutter does not operate normally).

Shutter speed table

JP1	ENB	ED0	ED1	ED2	shutter speed
X	L	X	X	X	shutter off
L	H	H	H	H	1/60[1)]
H	H	H	H	H	1/50[1)]
L	H	L	H	H	1/100
H	H	L	H	H	1/120
X	H	H	L	H	1/250
X	H	L	L	H	1/500
X	H	H	H	L	1/1000
X	H	L	H	L	1/2000
X	H	H	L	L	1/4000
X	H	L	L	L	1/10000

1) Accumulation time is as follows regardless of field accumulation / frame accumulation:
JP1 = low (EIA RS170), 1/60s
JP2= high (CCIR), 1/50s
(Pseudo field readout during frame accumulation)

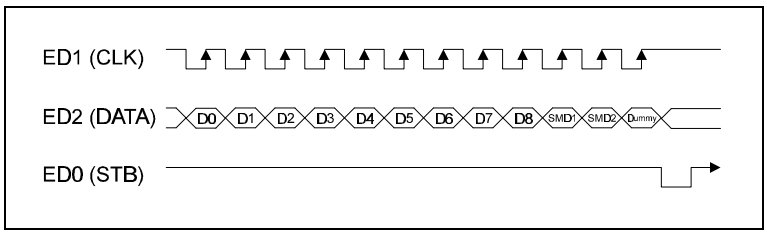
Serial Input The following four modes can be selected according to the combination of serial data SMD1 and SMD2.
(During frame accumulation, low-speed shutter does not operate normally).

Shutter Mode

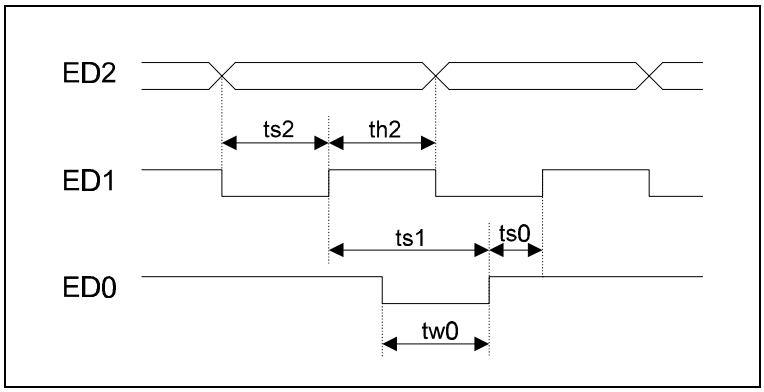
mode	flickerless	high-speed shutter	low-speed shutter	no shutter
SMD1	L	L	H	H
SMD2	L	H	L	H

flickerless: eliminates flicker resulting from the frequency of fluorescent light
high-speed shutter: shutter speed higher than 1/50 (CCIR)
shutter speed higher than 1/60 (RS170)
low-speed shutter: shutter speed lower than 1/50 (CCIR)
shutter speed lower than 1/60 (RS170)
(does not operate normally during frame accumulation
no shutter no shutter operation

Input timing when using serial input



The data on ED2 is latched in the register at the rising edge of ED1 and is then taken in internally while ED0 is low.



symbol		min:	max:
ts2	ED2 setup time against the rising edge of ED1	20ns	
th2	ED2 hold time against the rising edge of ED1	20ns	
ts1	ED1 rising setup time against the rising edge of ED0	20ns	
tw0	ED0 pulse width	20ns	50µs
ts0	ED0 rising setup time against the rising edge of ED1	20ns	

Shutter speed calculation
(During frame accumulation, low-speed shutter does not operate normally).

High-speed shutter
... for CCIR: $T=[312_{10}-(1FF_{16}-L_{16})] \times 63.56 + 34.78\mu s$
... for RS170: $T=[262_{10}-(1FF_{16}-L_{16})] \times 64 + 35.6\mu s$
(L_{16} = load value)

CCIR			RS170		
load value	shutter speed	calculated value	load value	shutter speed	calculated value
$0C8_{16}$	1/10000	1/10040	$0FA_{16}$	1/10000	1/10169
$0CA_{16}$	1/4000	1/4394	$0FC_{16}$	1/4000	1/4435
$0CE_{16}$	1/2000	1/2068	100_{16}	1/2000	1/2085
$0D6_{16}$	1/1000	1/1004	108_{16}	1/1000	1/1012
$0E6_{16}$	1/500	1/495	118_{16}	1/500	1/499
$1o5_{16}$	1/250	1/250	137_{16}	1/250	1/252
143_{16}	1/125	1/125	176_{16}	1/125	1/125
149_{16}	1/100	1/120	196_{16}	1/100	1/100

Low-speed shutter
$N = 2 \times (1FF_{16}-L_{16})$ FLD
However, 1FF cannot be used as the load value.
Maximum 1023 fields à20ms (= 20 seconds).

load value	shutter speed (FLD)
$1FE_{16}$	2
$1FD_{16}$	4
...	...
101_{16}	508
100_{16}	510

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CSYNC Composite synchronisation output

TTL level

VSYNC Vertical synchronisation output

TTL level

MODE Switch between field-frame readout and integration

TTL level

mode	readout
low	field
high	frame

GENLOCK External synchronisation

Input to synchronise the camera to an external video device.
A video signal (75Ω) or a TTL signal, consisting of horizontal and vertical synchronize pulses (composite sync, CSYNC) is needed. (Internally there is no 75Ω termination.)
The synchronisation is achieved by an internal PLL.

The synchronisation with Genlock can be enabled/disabled by controlling LSW. This can be done with DIP switch S1:

DIP switch S1/pin 8 = open Genlock disabled
DIP switch S1/pin 8 = closed Genlock enabled

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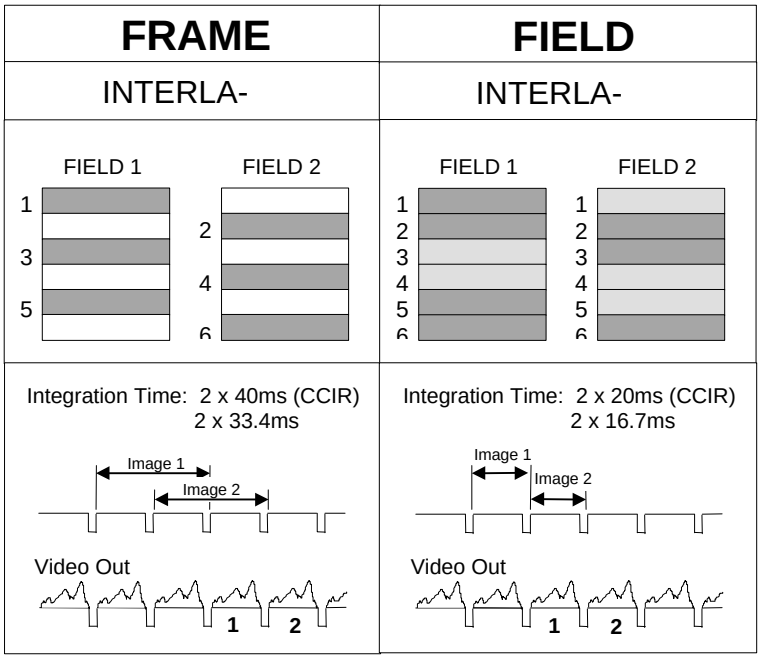
1.4 Mode Settings

Operating Mode

The camera runs in two different operating modes:

- FRAME interlaced
- FIELD interlaced



Hint

At continuous illumination the brightness of the image is the same in FIELD or FRAME mode:

CCIR: 40ms with 1 pixel or 20ms with 2 pixels
RS170: 33ms with 1 pixel or 16.5ms with 2 pixels

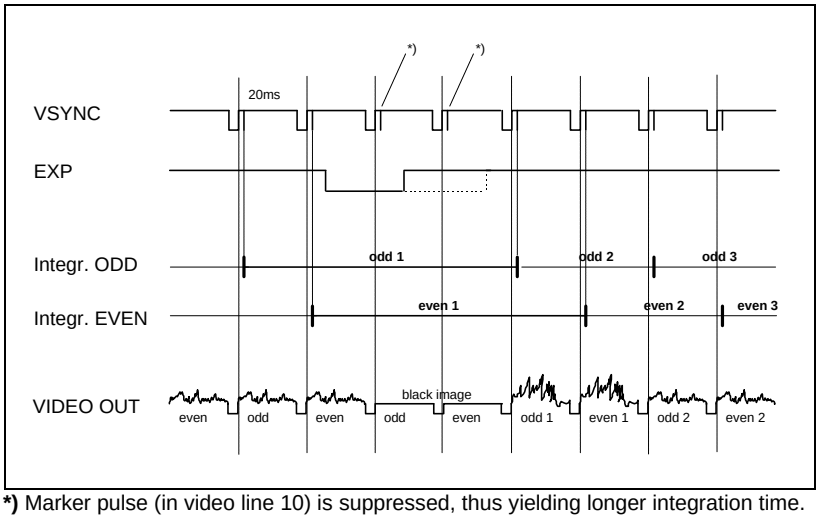
However, with externally applied shuttering (e.g. flashlight or laser pulse), the FIELD mode generated image has double the brightness of a FRAME mode generated image.

In the FRAME interlace mode the camera produces two fields generated with a time shift FIELD 1 and FIELD 2 (odd respect. even lines). These fields are each integrated for 40ms.

The FIELD interlace mode combines 2 lines (1+2, 3+4, ... in FIELD 1 and 2+3, 4+5, ... in FIELD 2). FIELD 2 is shifted by one line in respect to FIELD 1 (line shifting).

Long Exposure in Frame Mode

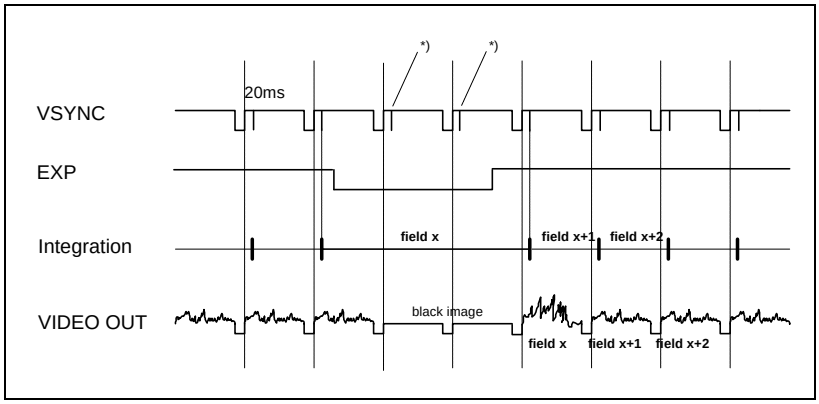
By using the EXP (= exposure) input (pin 3 of the 12-pin socket) the integration time can be controlled.
In line 10 of the video signal a marker pulse is allocated. If in this moment the EXP signal is "high", the marker pulse is suppressed, the image is not shifted into the shift-register and the integration time is prolonged.
When operating in the FRAME mode, always **2 x n** marker pulses are suppressed, to achieve two evenly illuminated fields (40ms). During the integration, black pictures are released from the camera.



***)** Marker pulse (in video line 10) is suppressed, thus yielding longer integration time.

Long Exposure in Field Mode

Via the EXP signal the integration time can be controlled. In line 10 of the video signal a marker pulse is allocated. If in this moment the EXP signal is "high", the marker pulse is suppressed, the picture not shifted in the shift register and integration time prolonged.
The FIELD mode allows integration time prolongation in steps of 20ms. During the integration, black pictures are released from the camera.



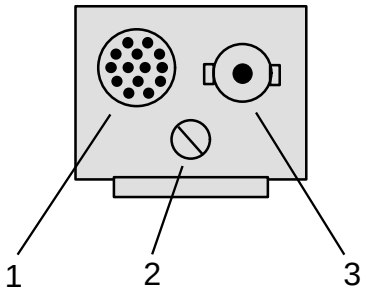
***)** Marker pulse (in video line 10) is suppressed, thus yielding longer integration time.

Shutter Mode

In the shutter mode, exposure times between 1/50 ... 1/10000 s can be realized. These shutter times can be achieved by a parallel and serial programming via external signals (ENB, ED0, ED1, ED2) or by a parallel setting via internal DIP switches.

Gain Control

The gain is externally adjustable with the potentiometer at the back panel of the camera. It can be selected in the range of ± 12dB.



1 12-pin Socket
2 Gain Potentiometer
3 Analog Video Output

Gamma Setting

The gamma correction is preset by factory to "linear".
If you want to change it, internal changes are necessary (see Chapter 2).

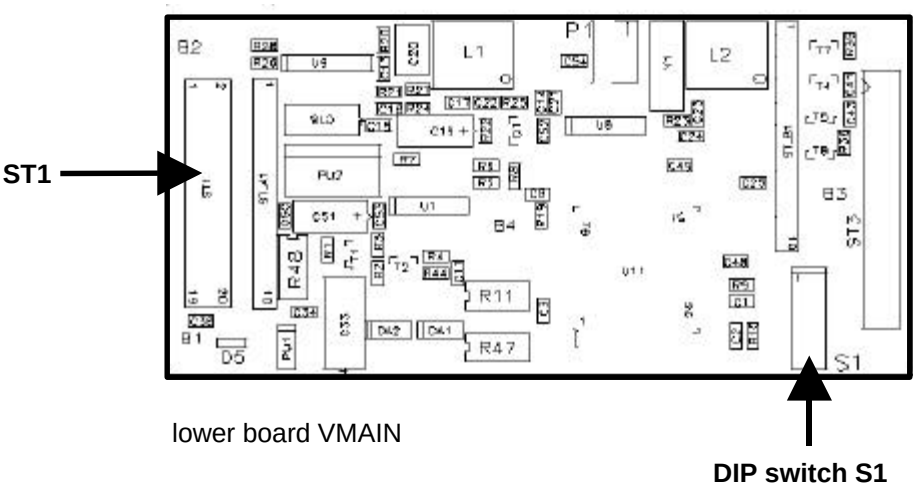
2. Video Module VM45

The main features of the Video Module VM45 are identical to these of the Video Camera VC45.
In this Chapter you will find some additional information to the Video Module VM45.

Please note that there are parallels between the 12-pin socket at the camera rear panel and the internal connector ST1.

Pinning of the I/O Connector ST1

The connector ST1 is placed on the lower (larger) board. Some signals has parallel wires to the I/O connector ST1 and to the DIP switch S1.
When using the external interface (I/O connector ST1) all DIP switches must be set to off!



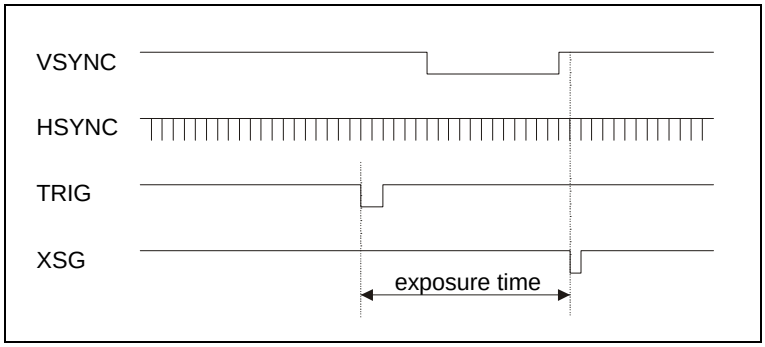
lower board VMAIN

DIP switch S1

pin at internal connector ST1	signal name		pin at 12-pin connector	function
1	GND	X	1	ground
2	+12V	X	2	input power
3	GND	X	1	ground
4	+5Vout		--	input or output power
5	GND	X	1	ground
6	VIDEO		--	video out
7	TRIG		--	trigger input
8	GAIN ext		--	external gain
9	ENB	X	5	enable shutter
10	ED0	X	6	shutter control
11	ED1	X	7	shutter control
12	ED2	X	8	shutter control
13	EXPD	X	4	exposure power down
14	EXP	X	3	exposure
15	CSYNC	X	9	composite sync
16	MODE	X	11	frame / field integration
17	VSYNC	X	10	vertical sync
18	HSYNC		--	horizontal sync
19	VR		--	vertical reset
20	GENLOCK	X	12	genlock

The ‘X’ marked signals are already described in Chapter 1 (see page 9).

GND	Ground
+12V	see Chapter 1, page 9
+5Vout	Output of a +5V
	Regulated by an internal voltage regulator (7805). When the voltage regulator is not needed you can also use an external 5V power supply. In this case the regulator has to be bridged.
VIDEO	Video output signal, CCIR or EIA RS170
	$1V_{pp}$, 0.3V Sync-Level on 75Ω
TRIG	Trigger mode
	Continuously variable shutter When using the normal shutter, either leave the TRIG pin open or connect it to the power supply. When using the continuous variable shutter, input the clock pulse to the TRIG pin When using the TRIG pin to control the exposure time, in order to broaden the control range it is necessary to use the ED=, ED1, and ED2 pins to set the shutter speed to 1/10000.



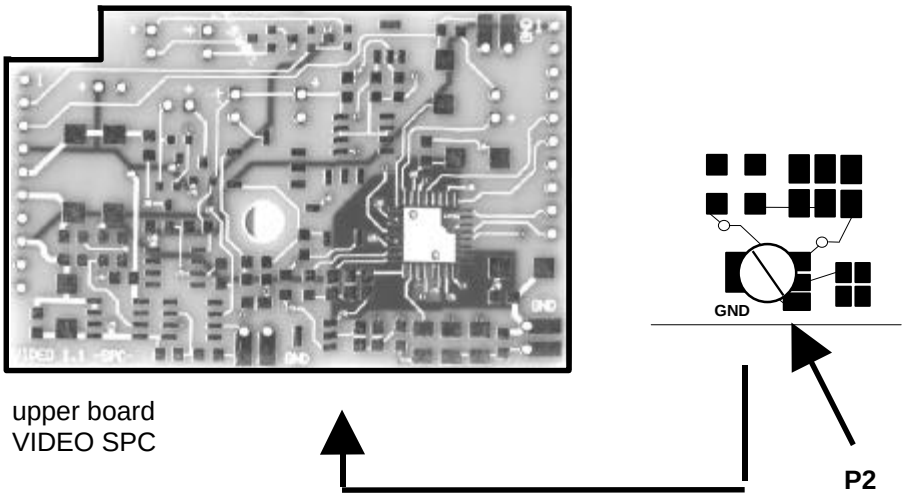
From the start of the TRIG input (falling edge) to the XSG pulse there is a variable exposure time.
The XSG pulse is done in the following lines after the vertical sync has ended:

CCIR	8 lines 8.5 lines	odd field even field
EIA RS170	1.5 lines 1 line	odd field even field

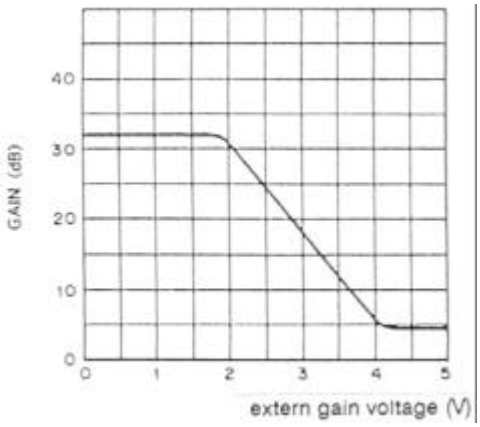
GAIN ext External gain setting

There are three possibilities to control the gain:

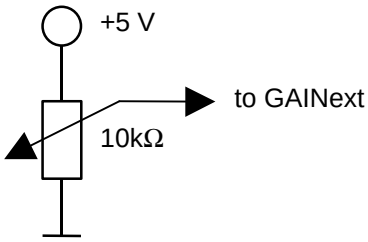
- Internally by the potentiometer P2



- Externally with a voltage range of 0 ... 5V
  The gain range is between 5 ... 32 dB.



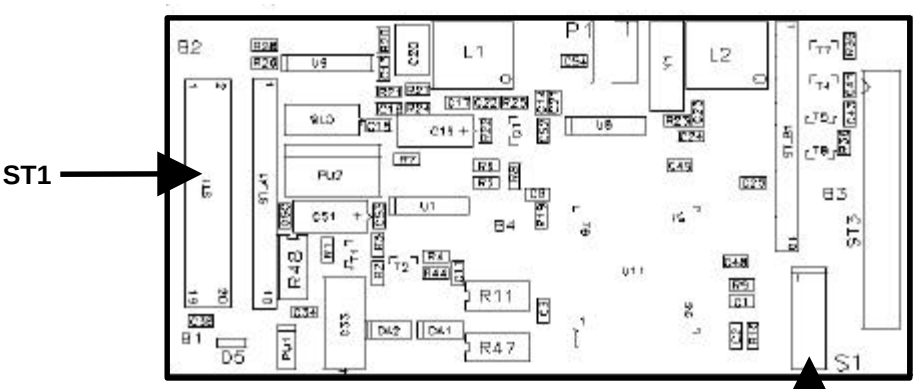
- Externally with a potentiometer:



ENB	see Chapter 1, page 11
ED0	see Chapter 1, page 11
ED1	see Chapter 1, page 11
ED2	see Chapter 1, page 11
EXPD	see Chapter 1, page 10
EXP	see Chapter 1, page 9
CSYNC	Composite synchronisation output (CSYNC) TTL level
MODE	see Chapter 1, page 13
VSYNC	see Chapter 1, page 13
HSYNC	Horizontal synchronisation output (HSYNC) TTL level
VR	Vertical reset input (TTL level) A vertical image synchronisation can be made with a vertical sync signal
GENLOCK	External synchronisation Input to synchronise the camera to an external video device. A video signal (75Ω) or a TTL signal, consisting of horizontal and vertical synchronize pulses (composite sync, CSYNC) is needed. The synchronisation is achieved by an internal PPL. A second possibility is to input separately the horizontal sync and the vertical sync. In this case the horizontal sync must be connected to the GENLOCK and the vertical sync must be connected to the vertical reset (VR). The synchronisation with Genlock can be enabled/disabled by controlling LSW. This can be done with DIP switch S1: DIP switch S1/pin 8 = open Genlock disabled DIP switch S1/pin 8 = closed Genlock enabled

DIP switches

The 8 DIP switches have the following function:



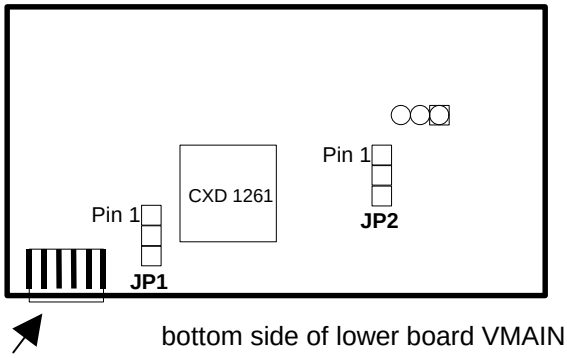
lower board VMAIN

DIP switch S1

DIP switch S1	function	factory set
1	TRIG	open
2	ENB	closed
3	ED0	open
4	ED1	open
5	ED2	open
6	Mode	open
7	PS (parallel / serial)	open
8	Genlock	open

CCD select and standard

The following jumpers are factory settings **and are not allowed to change!**



JP1: EIA RS170 or CCIR setting

EIA RS170

CCIR

JP2: 1/2“ sensor or 2/3“ sensor

1/2“ sensor

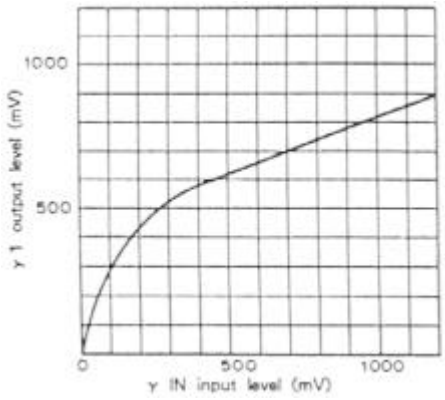
2/3“ sensor

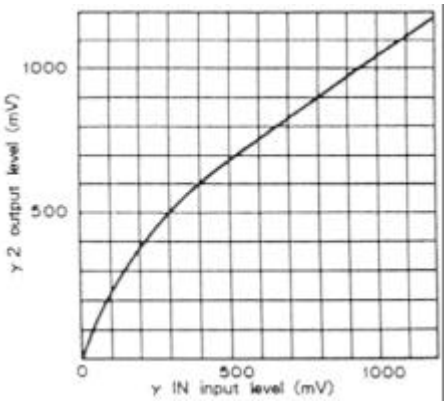
Gamma Setting

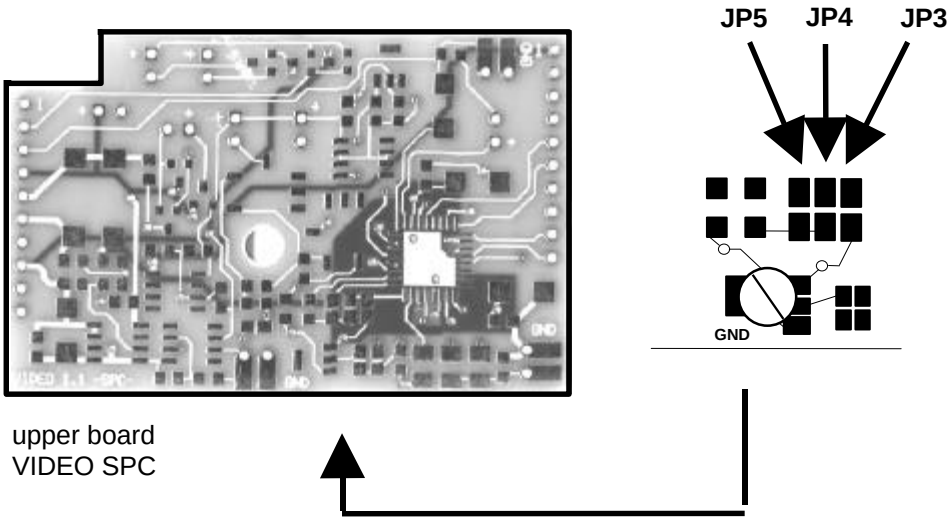
The gamma setting can be done with the jumpers JP3, JP4 and JP5, jumpered on the board "Video SPC".

	JP3	JP4	JP5
Linear	off	on	off
Gamma 1	off	off	on
Gamma 2	on	off	on

Other combinations are not allowed !!







3. Servicing, Maintenance and Cleaning Instructions

Servicing, Maintenance and Cleaning Instructions

The camera is maintenance-free.
Factory settings make any inspection and servicing superfluous.

During use the camera should be protected from hard shocks or strong vibrations.
Also should the camera be protected from high humidity and temperature shocks. Avoid exposing to sunlight, since it heats up the camera housing unnecessarily and prevents the cooling from reaching its optimum operating temperature.
Keep apertures and slots free to allow air to circulate.

Objective lens or lens adapter should be screwed in gently. Avoid forcing as it will damage the tread.

Use a soft and dry cloth to clean the housing.

Cleaning Method for the Optical Part

In principle every cleaning method bears the danger of damaging an optical surface.
Therefore clean only if it is strictly necessary.

As a first step use dry air to blow out dust particles. Avoid strictly to wipe on a dry glass surface.
In case dirt cannot be removed by blowing, use special optical cleaning fluids. Adequate fluids for optical surfaces are: pure dehydrogenated alcohol, pure acetone or cleaning fluids available in photo shops. Use a soaked cotton tip and take care to wipe only on glass surfaces, avoiding contact to metal surfaces, e.g. C-Mount thread, otherwise microscopic dirt and metallic chips are released, causing irreparable scratches on the glass surface.

Never use aggressive cleaning substances, e.g. benzine, spirit, nitro solvents, etc. commonly found in labs. Such substances may destroy or damage the surface on which they are applied.
The best is to avoid any dirt on optical parts, e.g. by replacing immediately the black protection cap when removing the objective lens. Do not leave the camera's optical input window open, without lens or protecting cap.

Our warranty does not cover damaged optical surfaces caused by improper cleaning methods.

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4. Appendix

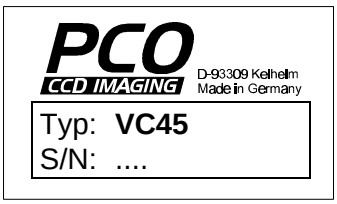
Customer Service

Having a problem or a question about matters not handled in these operating Instructions, we recommend to contact us :

... by phone +9441 / 2005-0

... by fax +9441 / 2005-20

...by email support@pco.de



For a quicker reply we need following information:

- Short description of the problem
- experiment conditions
- Camera serial-number (on the label placed on the bottom of the camera)

Warranty

PCO grants a 12 month warranty period for the camera. The warranty period starts on day of delivery ex-factory. In case of defect within the warranty period replacement or repair will be made (at PCO's discretion) free of charge. The device shall be returned on customer's expenses to PCO, preferably in the original package.
PCO is not liable for consequential damages.

Before returning the camera, contact PCO via any of the Customer Services.

Pay attention to use a sufficient package if you have to send the camera via mail (keep the original package).

Attention Opening of the camera or improper handling (e.g. damage by electrostatic charge, wrong cleaning method) voids the warranty.

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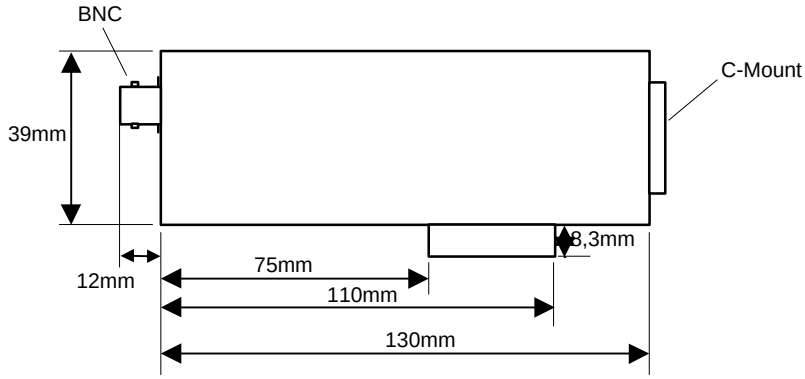
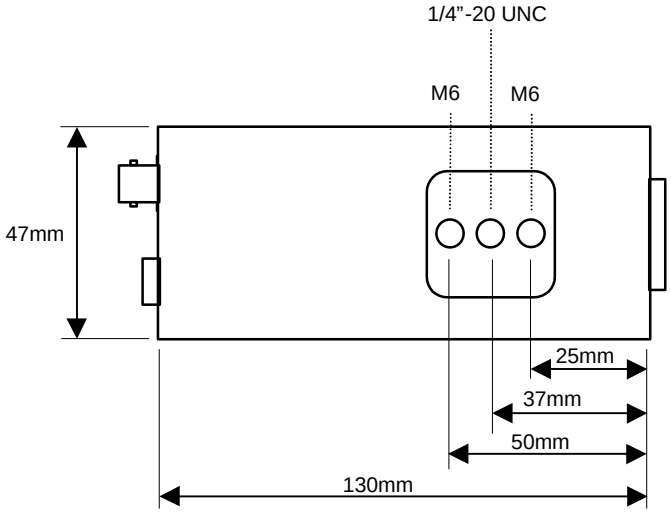
CE-Certification

VC45 complies with the requirements of the „EMC Directions of the European Communities (089 / 336 / EWG)“ and therefore bears the CE-Marking.

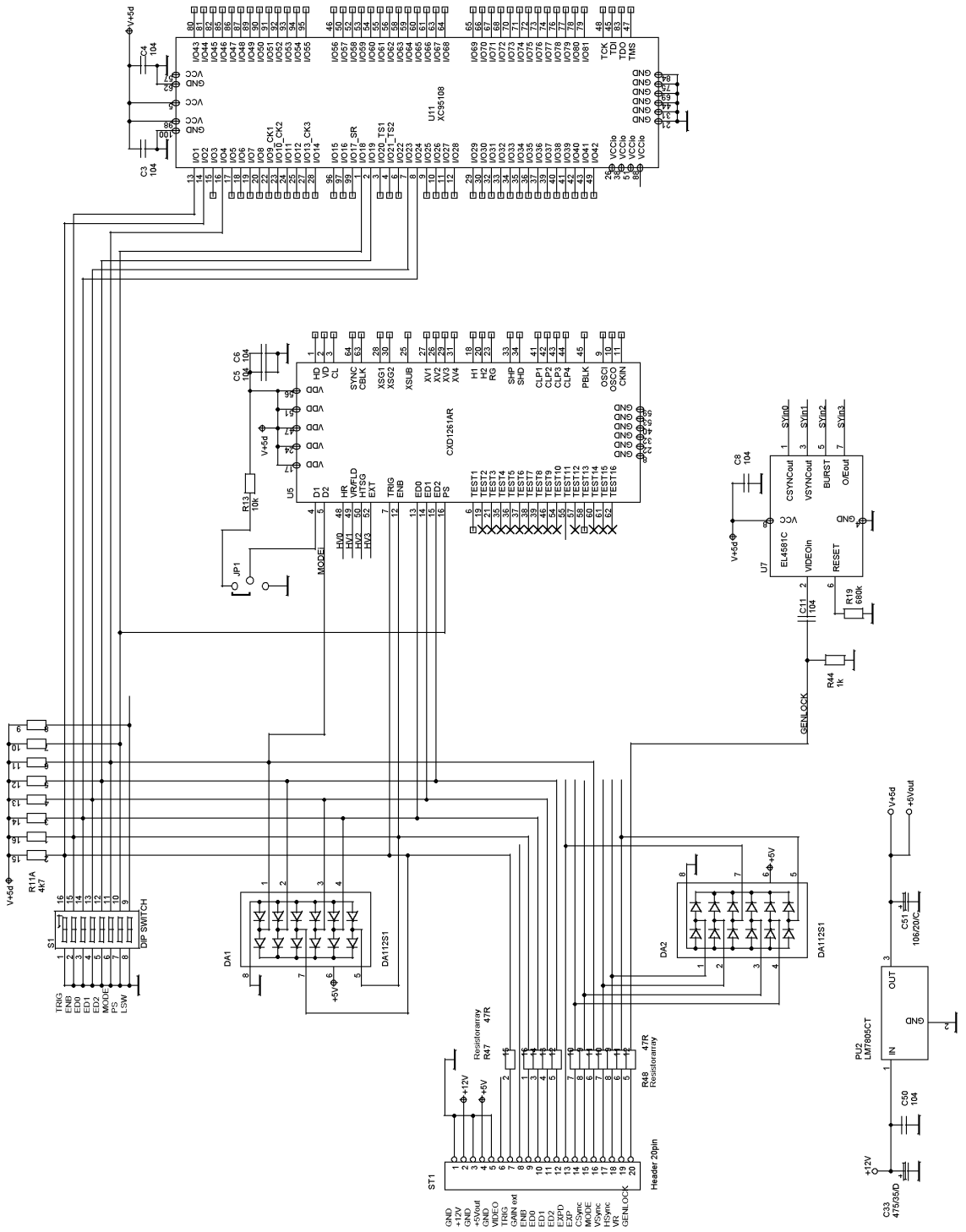
Dimensions and Weight





Weight: about 300g

Electrical Schematics of the board VMAIN



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System Data

Model	VC45-C-12	VC45-C-23	VC45-N-12	VC45-N-23
Sensor format	1/2“ sensor	2/3“ sensor	1/2“ sensor	2/3“ sensor
Video Standard	CCIR		EIA RS170	
Pixel Resolution	741 x 576	741 x 576	756 x 486	756 x 486
Pixel Size	8.6 x 8.3µm	11.6 x 11.2µm	8.4 x 9.8µm	11.6 x 13.5µm
Active Sensing Area	6.4 x 4.8mm	8.6 x 6.5mm	6.4 x 4.8mm	8.8 x 6.6mm
Horizontal Scanning Frequency	15.625 kHz	15.625 kHz	15.734 kHz	15.734 kHz
Vertical Scanning Frequency	50Hz	50Hz	60Hz	60Hz
Aspect Ratio	4/3 (hor./ver.)		4/3 (hor./ver.)	
max. S/N ratio	> 55dB		> 55dB	
Gamma	linear, gamma 1, gamma 2		linear, gamma 1, gamma 2	
Shutter Control	100µs ... 20ms		100µs ... 16.7ms	
Long Exposure	Internal: up to 20s External: up to DC		Internal: up to 20s External: up to DC	
Gain Control	internally or externally		internally or externally	
Operating Mode	FRAME or FIELD interlaced		FRAME or FIELD interlaced	
Power Supply	12V DC		12V DC	
Weight	290g		290g	
Dimensions	47(W) x 39(H) x 130(L) mm		47(W) x 39(H) x 130(L) mm	

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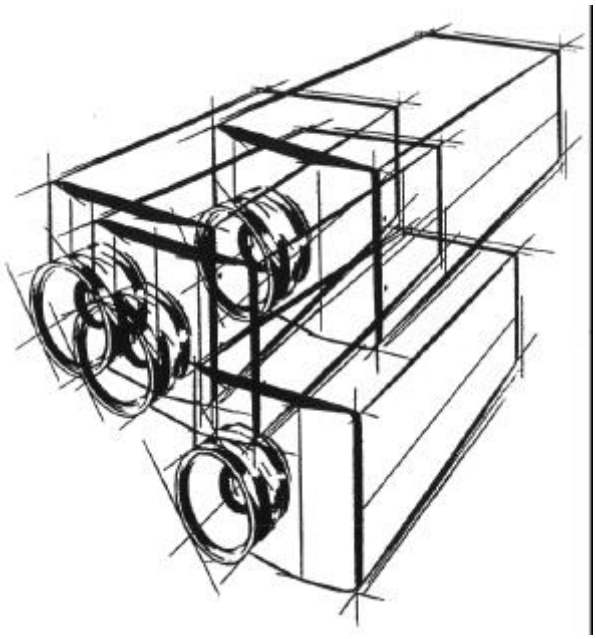
Dear Customer,

We hope the **VC45 / VM45** will be an always valuable tool for your scientific day in, day out work.

Comments, suggestions or any new idea on our system are welcome.

We are at your disposal at any time, also after your buying of this camera.

Your PCO Team



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